

1. Write an EMSO formula for the existence of an independent dominating set (a set  $S$  of vertices is an independent dominating set of  $G$  if  $G[S]$  is an independent set and every vertex is in  $S$  or a neighbor of a vertex in  $S$ ).
2. Use the cops and robber game to show that the  $k \times k$  grid has treewidth at least  $k$  (easier: at least  $k - 1$ ).
3. Design a dynamic programming algorithm for MINIMUM DOMINATING SET parameterized by treewidth.
4. What would be the subproblems of a dynamic programming algorithm for HAMILTONIAN CYCLE parameterized by treewidth?
5.
  - (a) Show that a graph not having a cycle of length at least  $k$  has bounded treewidth (hint: DFS).
  - (b) Give an FPT algorithm for finding a cycle of length *at least*  $k$  (Note: parameterized by  $k$ , treewidth does not appear in the problem description).